No. 129 July 2006

# solplan review

*the independent journal of energy conservation, building science & construction practice*

## Inside . . .



# Keeping Water Out of the Basement

Publication Mail Agreement No. 40013363

# From the Editor . . .

Energy efficiency improvements can be mandated or they can be encouraged. Few really are happy with mandatory regulations. However, mandatory requirements are one way of ensuring that everyone takes minimum actions. Voluntary action often has a limited impact, despite free marketers' stress that the marketplace is the most efficient way to encourage advancement.

Voluntary market transformation initiatives, such as the Built-Green programs in Alberta and BC can have an impact, although they still rely on public sector participation in the development of the evaluation protocols, and to provide added credibility. Similarly, in the commercial and institutional sector the green building initiatives such as LEED by the Canadian Green Building Council are important tools.

Unfortunately, these types of activities merely scratch the surface. They may have an influence, but in real terms they only influence a small segment that is predisposed to make improvements in their work. The vast majority just go along with what they need to do, and what they are told to do (i.e., what the minimum regulations call for). The marketplace is neither as free nor as responsive as proponents claim, especially in the building sector. There are many reasons for this, especially in more technologically complex activities such as construction.

A voluntary approach to energy improvement and energy efficiency upgrades was one of the bases for a lot of public programs. That was the rationale behind the Energuide for Houses program that the government scrapped. That was also the thinking behind Canada's Energy Efficiency Awards, administered by the Office of Energy Efficiency of Natural Resources Canada. It offered one way to encourage energy efficiency improvements, not just for new and existing houses, but also commercial buildings, industrial and transportation activities as well as students. Awards are one way to highlight and recognize the best, most meaningful actions taken.

Evidently, the power brokers haven't quite understood that actions speak as loud as words. As part of the new political regime in Ottawa, Canada's Energy Efficiency Awards have been discontinued. This is the latest in a series of actions that are offering proof to the Canadian public that energy efficiency and the environment are of little interest or consequence to the current government.

Then again, they are in good company, as they are following in the footsteps of the US, where the US Department of Energy is cutting funding for energy efficiency programs. US agencies and programs are facing severe cutbacks just as the world is recognizing the importance of the need to reduce energy consumption. Layoffs at government laboratories are in the offing. Funding cutbacks are so severe that researchers have no means to go to conferences and meetings to present findings of their research.

This is happening in spite of the scientific evidence that we must take aggressive action to deal with environmental climate change issues. Mandatory requirements are not the only way to deal with these issues. Both mandatory and voluntary actions must be taken. We don't have the luxury of years before any serious action is taken. But we've got to start today.

Richard Kadulski, Editor

**solplan review**
the independent journal of energy conservation, building science & construction practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: Dave Birmingham, Stephen Thwaites, John Carroll, Rob Dumont, James Reardon, Janet Ansell
ISSN: 0828-6574
Date of Issue: August 2006
SOLPLAN REVIEW is published 6 times per year by:
**the drawing-room graphic services ltd.**
PO Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3
Publications Mail Agreement No. 40013363

Postage paid in Vancouver, BC.
Return undeliverable Canadian addresses to
PO Box 86627, North Vancouver, BC V7L 4L2

SUBSCRIPTIONS: In Canada 1 year $51.94 (incl GST) (NB, NS, NF $55.86 includes HST); 2 years $93.28 (incl GST) (NB, NS, NF $100.32 includes HST). USA and other foreign payable in US $ 1 year $56.00, 2 years $102.00.

CHANGE OF ADDRESS: include a mailing label or copy all information off label for faster, accurate processing.
CONTRIBUTIONS: Unsolicited contributions and manuscripts welcome. Include self-addressed pre-stamped mailer if return requested. Publisher not responsible for loss or damage of same.

PRINTED IN CANADA
GST Registration: R105208805




# Keeping Water Out of the Basement

Moisture problems seem to be a natural part of basements. Traditionally, basements were really just a part of the foundation. They were in-ground structures to accommodate the needs for structural bearing and frost protection. As well, they were a convenient storage cellar and coal or wood bin for the heating system.

As long as basements were unfinished service spaces, the quality of the indoor environment was not a priority. A damp, musty environment seemed to be a natural state of affairs.

Today basements are the largest source of warranty complaints. They often are expected to be a part of finished living space, which requires more attention to how they are built. Basement detailing must be done accordingly. When looking at foundation details, we need to consider the basement is a system.

Basements are surrounded by soil, which can be wet or frozen for long periods of time. They are subject to more structural and moisture loading than above-grade building elements and thermal flows may be out of sync with above grade as the basement is usually poorly insulated. Building codes set out minimum requirements, so they can't anticipate all site conditions that could be encountered and site conditions can vary drastically from location to location.

The number one problem with basements is moisture management. Concrete is not a waterproof material; rather, it is a brittle material subject to cracking. Concrete is also a large reservoir of moisture especially as it can absorb water from the ground through capillary suction of ground moisture. In addition, the cooler basement environment becomes a concern as condensation can occur on surfaces, leading to mold growth.

Recent awareness of mold problems in buildings has further underscored the need to properly deal with the design and construction of basements. In the litigious US environment, mold litigation has become a growth industry and estimates are that 50% of homes contain problem molds. This has led to a 1,300% increase in mold insurance claims between 2001 and 2004 (and payouts in the order of $3 billion), so it is no surprise that insurers now add mold exclusions to their policies, and this practice has been extended into Canada.

Obviously basements are not the only location for mold in houses, although they are a major source. It is much easier to prevent problems by using proper details and construction practices at the outset than try to remedy a problem once the structure is completed and occupied.

Remedial actions usually are very expensive to undertake and often may be inappropriate. Too often, ventilation and dehumidification strategies are used to solve the problem, but these will not do the job unless the source of moisture is dealt with.

There are ways to build basements to avoid moisture problems and reduce liabilities. Moisture management below grade means ensuring that not only good drainage be incorporated to remove moisture from around the foundation, but also that capillary breaks be built in to stop moisture from wicking and into the foundation wall.

It should go without saying that basements should not be built in flood prone areas or in high water table areas. Unfortunately, far too many houses are built in precisely such locations, with the homeowners suffering when the inevitable basement flooding destroys the finishes and the possessions stored there.

Footings should be isolated from the wet soil. One approach that builders in the Vancouver area are using is placing the footings on a layer of drain rock spread on the excavation. A drain rock layer is spread across the full excavation and it acts as capillary break and a water reservoir for peak rainfall events. This is not unlike the standard foundation approach used with pressure treated wood foundations. This not only reduces the moisture load into the foundation, but in a wet climate helps to keep

*Typical dimple sheet that creates a capillary break between foundation wall and soil. note that sheet is draped over the footing, to reduce moisture loading on concrete footing.*

*Footings set on top of drain rock layer spread across entire excavation. The drain rock provides a capillary break under footings, and also reduces moisture load on foundation.*

the construction site cleaner.

Another option for isolating the foundation wall from the ground is to wrap the footing in an impermeable membrane using either a waterproof fabric form, wrapping the footing with poly prior to pouring the footing, or placing an impermeable membrane on the top of the footing, thus decoupling the foundation wall from the footing and moisture.

Foundation walls also need to be properly protected against moisture. A common misunderstanding is that the damproofing applied to concrete foundation walls and required by the building code provides waterproofing protection. The damproofing coating is meant to reduce moisture infiltration into the concrete by capillary action. However, the protection afforded by the damproofing is modest at best, and not a durable solution. The asphalt coating, which is an organic material, is subject to degradation due to biological attack by microbes in the soil. That is why so often when a foundation wall is excavated, there is little evidence of any coating on the wall.

Proper foundation wall water management detailing requires exterior drainage materials. Traditionally, properly built foundations would have relied on permeable backfill. Today, a variety of products are available. One approach is to apply a waterproofing membrane, such as a liquid applied membrane, or a manufactured adhered membrane (often referred to as a peel-and-stick membrane). These require perfection in the application and maintenance to provide the waterproofing.

An alternate approach, until recently more commonly seen in commercial construction, is foundation drainage materials. These essentially are a way to introduce a capillary break against the foundation wall on the outside to reduce the water contact on the walls, minimizing backfill issues. Most systems rely on a dimpled sheet that keeps backfill off the concrete, so that should there be water in the soil, it will flow down into the site drainage rather than press against the concrete. Others are semi-rigid fiber boards, where the spaces between the fibers provide the drainage cavities.

In frost-susceptible regions, these products also reduce the potential for ice lensing problems as the ice is kept away from the concrete by creating a slip plane. ☼

### Foundation Drainage Products

| Product | CCMC # | Description | Manufactuer |
|---|---|---|---|
| Delta-MS | 12788-R | high-density polyethylene, semi-rigid plastic sheet membrane, with a dimpled surface on one side and a smooth surface on the other. | Cosella Dorken Products Inc.<br>Beamsville, Ontario<br>Tel.: (905) 563-3255<br>Fax: (905) 563-5582 |
| Delta-MS-Clear | 13197-R | a transparent high-density polyethylene sheet membrane, with a dimpled surface on one side and a smooth surface on the other. | |
| Wrap-N-Drain | 13079-R | polypropylene sheet roll with a dimpled surface on one side and a smooth surface on the other. | Advanced Coatings Inc.<br>Midland, Ontario<br>Tel.: (705)-534-4760<br>Fax: (705)-534-4125 |
| Superseal Dimpled Membrane | 13098-R | black polyethylene sheet roll produced from recycled (up 30% industrial waste) and virgin polymer with a dimpled surface on one side and a smooth surface on the other | Superseal Basement Systems Ltd.<br>Surrey, BC<br>Tel.: (604)-576-8190<br>Fax: (604)-576-2458 |
| Styrofoam™ Perimate™ | 12826-R | Type 4 extruded polystyrene rigid insulation board with vertical grooves that drain water down to the weeping tiles | Dow Chemical Canada Inc.<br>Weston, Ontario<br>Tel.: (416) 744-5612<br>Fax: (416) 744-5601 |
| Platon | 12878-R | a high-density polyethylene sheet roll with a dimpled surface on one side and a smooth surface on the other. | Armtec Limited<br>Orangeville, Ontario<br>Tel.: (519) 942-2643<br>Fax: (519) 942-2850 |
| DrainBoard | 12718-R | high-density mineral wool insulation board 1" thick made from rockwool | Roxul Inc.<br>Milton, Ontario<br>Tel.: (905) 878-8474<br>Fax: (905) 878-8077 |
| DMX FlexSheet | 13182-R | black dimpled high-density polyethylene membrane with dimples. | DMX Plastics Limited<br>Toronto, Ontario<br>Tel.: (416)-751-5851<br>Fax: (416)-751-6851 |



# Certifying the Sun

With worldwide energy demand growing and fossil fuel supplies dwindling, attention has been turning toward the earth's largest source of clean, green power -- the sun.

The sun provides vast amounts of energy every year that can be converted into electrical energy through the use of photovoltaic (PV) panels. PV panels have been used for decades to power items from spacecraft to calculators. For years, boaters and recreational users have supplemented fuel-fired generators with PV panels. In the last 10 years much effort has gone into building integrated PV to take advantage of the large surfaces that buildings offer. And it can provide power directly to the users.

The Canadian PV market is still small, but it has grown by an average of 25 percent annually from 1995 to 2002.

While PV panels are readily available to builders and homeowners, as with any technology, there is always the issue of whether they perform safely and reliably, especially under Canadian conditions. Underwriters' Laboratories of Canada (ULC) and Underwriters Laboratories Inc. (UL) have partnered with Bodycote Testing Group (BTG) of Mississauga to test and certify the safety and performance of PV panels to national and international standards. Certified products will carry the cUL and/or UL Certification Marks to signify compliance.

At its Mississauga laboratories, BTG subjects PV panels to a range of simulated sun, wind, rain, and temperature conditions to evaluate their performance. Other tests include climatic cycling to simulate freezing and high humidity and temperature conditions, impact tests, and electrical tests.

It may not be well known, but Canada's colder climate makes PV panels perform better than in warmer climates because excessive heat build-up is avoided. As well, contrary to popular belief, average annual sunlight hours in southern Canada are comparable to that in Germany, which has many successful PV installations.

Net metering programs now being introduced in Canada are allowing building owners to run their electrical meter backwards when the building generates more electrical power than it can use. Surplus power is fed back into the electrical grid systems and the building owner's electrical bill is reduced accordingly.

The net metering regulations in Germany and Spain have made those countries leaders in renewable energy applications. Germany alone has seen the installation of more than 110,000 PV systems.

The Ontario Government recently unveiled a renewable energy incentive program that will allow homeowners, businesses and commercial energy producers to sell clean power to the grid. Solar photovoltaic energy is one example of clean power that can be fed into the grid. Ontario's Renewable Energy Tariffs will offer $0.42/kWh for PV energy over a 20-year term with adjustments for inflation. The residential retail price for electricity in Ontario is presently under $0.06/kWh. ☼

# An Introduction To Wall Bracing for Housing and Light Frame Construction

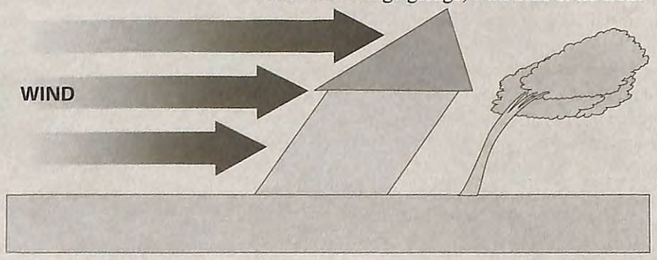
*By Dave Birmingham*
*Engineered Wood Specialist,*
*APA – The Engineered Wood Association*

New advances in design and technology of conventional low-rise residential buildings transform the way we build, but the process remains relatively simple. It is important to remember, however, that residential structures have frequently suffered the brunt of the damage caused by earthquakes, hurricanes and other extreme weather events. Recent global weather trends indicate that these events may increase in both frequency and occurrence. Residential design must take potential damage from such events into consideration.

Housing and small buildings in Canada can be built without the requirements of a full structural design using prescriptive requirements found in Part 9 of the building code. Some of these requirements are based on calculations; others are based on proven performance over time. Wall bracing requirements, based on a combination of both, have been scrutinized in recent years.

According to traditional National Building Code of Canada (NBCC) bracing requirements, diagonal bracing was specified at the corners of wood framed walls to provide resistance against wind racking forces. Laboratory tests performed at the National Research Council (NRC) in the late 1950s indicated that non-structural components such as gypsum contributed to a wall's lateral strength and stiffness, which eliminated the need for external wall bracing.

Home sizes have since doubled and designs have changed dramatically. Tall walls, great rooms and sunrooms are popular, as are the increase in the number and sizes of window and door openings. Open space featuring fewer interior walls has become fashionable. The bonus room over a large garage, with little or no front wall, is also in vogue. Garages have been known to fail by racking when the sections on either side of the garage opening are not capable of resisting lateral loads caused by extreme weather events.




*Walls must be strong enough to resist the wind forces that push against the home.*

The composition and installation of interior gypsum products has also changed. Gluing of the gypsum has become common practice in some areas of the country. The use of glue is a questionable practice if the gypsum is to be considered a non-structural bracing panel because it can make the failure mode more brittle.

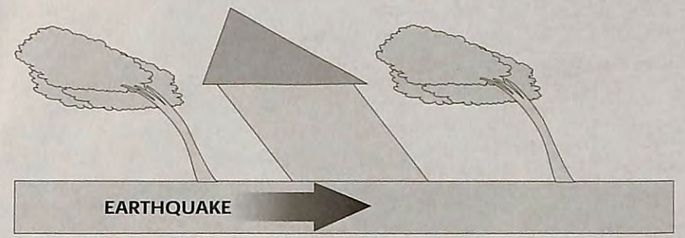
Bond durability of adhesives over the life of the structure is another consideration. Gypsum manufacturers often promote the use of the 'floating interior angle system'. While this approach alleviates some joint cracking at corners and allows gypsum to perform as an interior finishing panel, it does not perform properly as a non-structural bracing panel. A bracing panel should be nailed to the top or bottom plate or corners to properly transfer those lateral forces; otherwise, the walls may rack or become unstable in the event of extreme weather or earthquake. Countries like Australia that have experienced catastrophic housing failures will allow builders and designers to count the interior gypsum panels as bracing only if it is mechanically fastened and attached to the top and bottom plates and corners.

Any building, regardless of size or location, must be designed safely to resist the structural loads anticipated during its lifetime. These loads can be divided into two categories: vertical loads and lateral loads. Vertical loads act in the up and down direction. Simply put, they are the gravitational loads or weights of materials. Because these loads are easy to understand, construction practices typically accommodate them in an efficient manner. On the contrary, lateral loads, caused by earthquakes and high wind events, can be quite complex. These loads are parallel to the ground, acting sideways and coming from any direction. The side-to-side motion acting along the long axis of the wall will cause the wall to rack out of square or, in a worst-case scenario, collapse. The solution to racking is bracing.

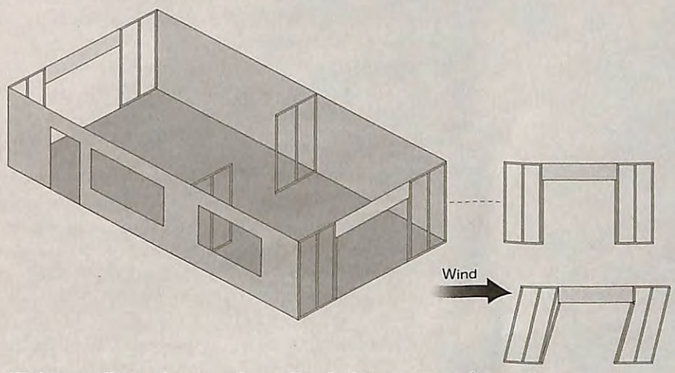
Typically in residential construction, a wall frame consists of top and bottom plates and studs. The frame on its own has little or no



in-plane stiffness. For a clad wall, the sheathing material almost entirely provides the lateral resistance. To get an idea of how a lateral load influences a wall, imagine nailing two studs to a top and bottom plate. Push gently against the top of one stud from the side and see how easily the frame leans in the direction against the force. Now attach a structural panel (OSB or plywood)




*In an earthquake the seismic ground motion acts on the foundation*




*Without sufficient bracing the walls of a house can rack, causing cosmetic damage, performance problems and even structural failure.*

to the same frame and notice how difficult it becomes to rack out of square. The fundamental reason for having sheathing is to stabilize the framing members against forces acting parallel to the length of the wall. Un-braced walls will react in a similar manner when faced with wind or earthquake loads, causing the walls of the house to rack out of square and resulting in cosmetic damage, performance problems or even structural failure. A properly braced wall, on the other hand, will remain square, transferring the load down to the foundation.

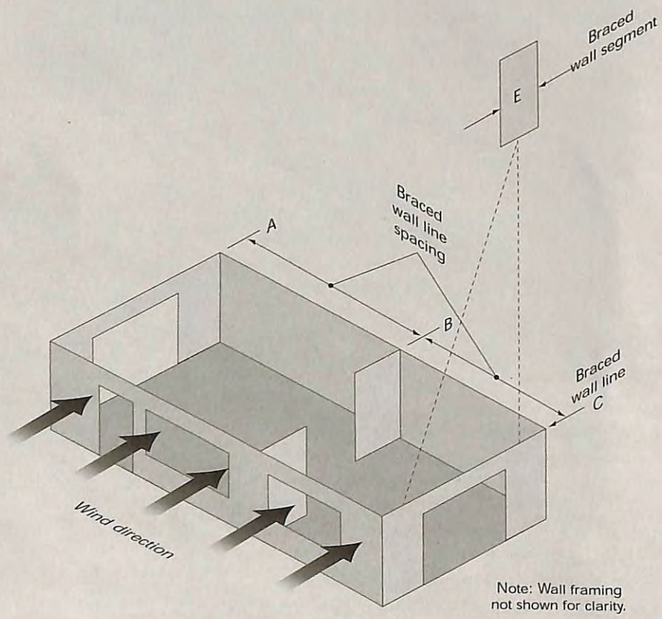
The lateral capacity of a wall is quite complex and depends on material properties, configuration of the frame and the connectivity of the components. Its complex nature is why wall bracing is one of the most confusing elements of any house, but it is also one of the most important structural elements.

Bracing can be categorized in a number of ways to include: temporary or permanent bracing, structural or non-structural bracing. Commonly recognized, braces include the 1-inch by 4-inch let-in or metal bracing as seen on rigid foam sheathed houses. Not all metal bracing is designed for permanent structural bracing; some manufacturers' product recommendations state that they are 'temporary' to prevent racking during construction before structural sheathing is applied. Such metal bracing should not be used as a substitute for shear wall bracing, as it offers only about 10 percent of the racking resistance. Non-structural type bracing may be interior gypsum that is mechanically fastened properly to the top and bottom plates; structural bracing, the OSB or plywood on the exterior wall. Walls with adequate bracing are unlikely to collapse during high wind or an earthquake.

### What are Braced Wall Segments and Braced Wall Lines?

The building codes typically use the terms braced wall panel and braced wall line. A braced wall panel is a segment or portion of a braced wall line. It consists of the wall panel (e.g., plywood or OSB sheathing), the framing and the fasteners. Multiple braced wall segments aligned primarily along the same wall line form a braced wall lines. Braced wall lines are what resist lateral loads in a house. Maximum spacing between

braced wall lines for buildings constructed according to proposed Part 9 Prescriptive Solutions are based upon seismic and wind load data. Braced wall lines typically can be no more than 7.6m (25') apart in high seismic regions and 12.2m (40') elsewhere. Maximum spacing between braced wall lines can be found in Table 9.4.1.3 of the proposed changes.




*Properly spaced braced wall lines, made up of braced wall segments, resist racking loads.*

### How Wide or Long Do Bracing Segments Have To Be?

Bracing terminology – like bracing – is often confusing. Some codes refer to width of a bracing panel or segment as they would to the width of panel; others, such as the Canadian code, refer to length of the bracing segment as you would to the length of a wall. The minimum length of the bracing segment typically depends on the bracing method or type of construction material specified.

Some codes allow for narrower width/length segments to be used for continuous wood structural panel sheathing because of its superior structural performance. Remember the vulnerable garage opening with little or no front return wall? The International Residential Code (IRC) in the U.S., for instance, requires these walls to be braced a minimum 48 inches wide. This is not practical from a design perspective in urban markets where small lots and large garages are the norm; therefore, the code gives special recognition for buildings that are continuously sheathed with wood structural panels by permitting narrow wall segments of 16 inches in length based upon APA testing. This allowance is also based on an extended header and specific nailing pattern. There is currently no limitation in Part 9 of the Canadian code as to the length of these walls. The proposed change limits the length to 300 mm with no special requirements for installation.

### How Much Bracing is Needed, and Where?

The amount of wall bracing needed in each braced wall line, as specified by codes depends upon the size of the building, wind and seismic loads acting upon the building and the number of stories in the building. Walls need to be stronger in areas of high wind or seismic activity; therefore, braced wall lines must be spaced closer together. Similarly, lower storey walls are subject to greater lateral loads so they need to be stronger than upper storey walls; therefore, the percentage of bracing in the wall line will tend to be higher. Bracing requirements can be found in the Engineering Guide For Wood Frame Construction, published by the Canadian Wood Council.

Many codes, including those in the U.S., require that all exterior wall lines in wood or light gauge steel construction be braced. Lateral load is often overlooked in the design of Part 9 buildings in the NBCC. One proposal suggests that Part 9 define configurations where lateral load analysis would be required. Proposed changes are a high priority for the next cycle. In the meantime, builders must recognize the importance of bracing. With walls continuously sheathed with wood structural panels, it is considerably easier to meet all bracing requirements, increase the racking capacity of the house, allow for straighter flatter walls, keep window and door openings square and reduce drywall cracking problems associated with racking, while providing the architectural appearance the home owners prefer. ☼



# All Windows Are Not Created Equal

*By Stephen Thwaites*

### How do you select windows?

Glass technology has changed significantly over the past few years. It is important to understand the changes and the impact that glass can have on houses when deciding on what type to use for a project. It is important to understand that all Low-E is NOT created equal.

If you had the choice between two windows that were exactly the same except one had a slightly higher R-value glass than the other, which one would you pick to lower your heating bill? Even if they are the same price?

If you picked the higher R-value window you could be wrong - wrong to the tune of many hundreds of dollars over the life of the windows.

### Why is the answer not always the higher R-value window?

Windows allow solar gains that help heat the house. Currently the type of Low-E glass that insulates the best also stops more than half of the free heat from the sun from entering the house. If your heating bill is bigger than your cooling bill this is a bad thing. To understand how a window affects your heating bill you need to know not just how well it insulates but how well it collects the free heat from the sun.

The Energy Rating (ER) is the only one-number system that permits comparison of energy efficiency because it accounts for all the heat losses as well as the solar gains.

More can be less and less can be more when it comes to windows and the heating bill. The two extremes in the R-value/solar gain trade-off are Cardinal's Low-E$^2$ and Libby Owens Ford's (LOF) Energy Advantage II. If we look at a typical 24"x48" fiberglass casement window, we can compare the results (see table).

The location of the Low-E coating is different for the two options and reflects where most manufacturers put the coating.

When you compare glass properties you can see the two glass options both transmit about the same amount of visible light. In other words they look very similar. But their performance is significantly different. The LOF glass transmits 60% more solar heat than the Cardinal Low-E$^2$. Solar energy includes visible light energy as well as invisible UV energy and invisible infrared energy. All three 'flavors' of solar energy contribute to reducing your heating bill.

When the comparison moves to the U-value (R = 1/U), the ranking is reversed. Cardinal's Low-E$^2$ insulates 14% better than the LOF.

When you compare window properties for this example you can see similar results. SHGC stands for Solar Heat Gain Coefficient. It tells us how much of the solar energy that strikes the outside of the window (including the frame), makes it through the window. Looking at the SHGC you can see, not surprisingly, that the LOF Low-E delivers more solar energy than Cardinal's Low-E$^2$. Similarly the Cardinal Low-E$^2$ window has maintained its lead in the U-value, although the lead has been reduced by the effect of the spacers and frame.

The lower solar heat gain glass is more important in the southern US where cooling is a much bigger concern than heating.

*Thanks to Stephen Thwaites of Thermotech Windows Ltd. for this item*

## ER Ratings

A window's ER rating is a measure of its overall performance, based on three factors:

1) solar heat gains;
2) heat loss through frames, spacer and glass; and
3) air leakage heat loss.

A number is established in watts per square metre, which is either positive or negative, depending on heat gain or loss during the heating season. The range is wide.

Because all window Energy Ratings (ER) are evaluated the same way, it is easy to compare different manufacturers' products. However, the rating will be for standard-sized windows, but the ER will vary depending on window size, and whether or not it is a fixed window or an operable window.

A positive ER number means the window may add more heat to the home than it would lose during the heating season. A window with an ER of 0 (zero) loses as much heat as it gains over the heating season.

A negative ER means a window loses more energy than it gains. The lower the number, the more heat is lost. For example, an ER of -38 is worse than an ER of -20. An ER number of -11 is a good minimum performance level for an operable, standard high-performance window.

*For more information on windows and the ER window rating system, see Natural Resources Canada's Consumer's Guide to Buying Energy Efficient Windows. Copies can be accessed at: oee.nrcan.gc.ca/publications or oee.nrcan.gc.ca/energystar.*

*A copy can also be viewed at www.thermotechfiberglass.com*

| | GlassProperties | | | | Window Properties | | | |
|---|---|---|---|---|---|---|---|---|
| | Transmittance | | U-value | | | U-value | | ER |
| Glass Code | visible | solar | W/m²K | Btu/ft² | SHGC | W/m²K | Btu/ft² | W/m² |
| 211 (Cardinal E², #2) | 0.72 | 0.36 | 1..41 | 0.25 | 0.28 | 1.54 | 0.27 | -13.5 |
| 211 (LOF, #3) | 0.75 | 0.58 | 1.66 | 0.29 | 0.49 | 1.71 | 0.30 | -1.9 |

*1. Glass Code*
*1st digit - number of panes of glass*
*2nd digit - number of SuperSpacers*
*3rd digit - number of Low-E coatings and argon gas fills*
*The number after the Low-E manufacturer's name shows the location of the Low-E coatings - surface #1 is the exterior surface*

*2. Glass and window properties were determined by FRAME PLUS*

As far as your heating bill goes, the ER tells the tale. In this case the difference is 11.5 W/m². Over a 212 day heating season (typical for Canada and the northern US) this amounts to 1170 kWh for a typical house with 200 sq. ft. of windows. Over 20 years that difference accumulates to an expense that, depending on local energy rates, could be about $1600 for electric heating or about $900 for natural gas heating.

This may or may not be a lot of money to you, but when you consider that Cardinal's Low-E² is either the same price as the LOF Low-E or more expensive than LOF's Low-E it's a pretty easy decision to make. ☼

A double-glazed window has four surfaces - #1 is the exterior surface, #2 is the inside surface of the outside pane, #3 is the outside surface of the interior pane, and #4 is the interior surface. Low-E coatings are placed on either the #2 or #3 surface, depending on whether the intention is to primarily keep the heat in or out. In cooling climates, the intent is generally to reduce solar gains, while in heating climates, one wants to collect solar heat to lower the heating bills.

R-2000

For information on the R-2000 Program, contact your local program office, or call
1-800-387-2000
*www.R-2000.ca*

# Ventilation for Apartments:
## Ventmax IVS

Ventilation in apartments is a major challenge. A common approach is to pressurize the corridors with the expectation that the air will work its way into the apartments as exhaust fans remove stale air. However, that is a strategy that through many studies has been shown not to be effective.

Apartments are much smaller than the average new home, and they do not have the basements, crawl spaces or attics that can provide space for mechanical equipment. As a result, indoor air quality in apartments suffers.

Building on their experience with integrating heating and ventilation equipment, Nutech Brands Inc., manufacturers of the Lifebreath Heat Recovery Ventilators, have developed an integrated heating and ventilation unit that is well suited for apartments.

The Ventmax Integrated Vertical Stack with Heat Recovery Ventilator (HRV) is the first of its kind giving high-rise condos, apartments, and hotels a new ventilation option. The unit incorporates a hydronic coil for heating and cooling along with an HRV that brings fresh air from the outside. As a stand-alone unit, occupants can control their own heating and ventilation system. The built-in HRV uses Lifebreath's patented aluminum heat exchange core to transfer heat from the stale exhausting air to the fresh incoming air.

The unit is available with three different fan coil models that offer 1, 1.5 or 2 tons of cooling and provides 400 CFM to 800 CFM airflow. The unit has a small footprint (19"x19" and 84" tall) so it can fit into a small closet.

The Ventmax IVS has the flexibility to meet various building designs with its multiple configurations. It can be installed in a vertical stack or stand-alone application, while supply configurations can be direct supply or ducted.

Standard IVS units are equipped with PSC motors, but energy efficient ECM motors are available to provide the resident with additional savings. The typical power consumption of an IVS 1.5 with ECM motor at low speed is 20 watts. ☼

*Information:*
*www.lifebreath.com*



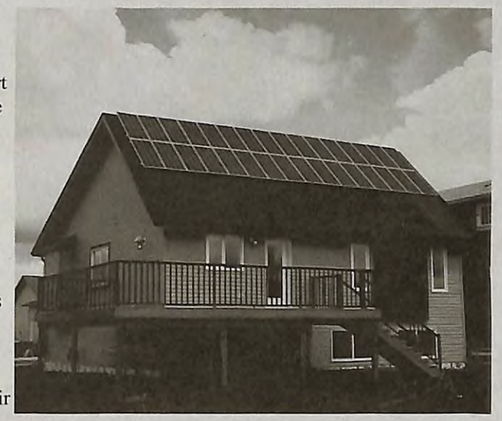
# Alberta Home Builder Builds Energy Efficient, Net-Zero Energy Home

Most Canadians from outside have an image of Alberta as a region awash in petro dollars with a total disregard towards the environment. That is why it is heartening to see that Alberta is also making meaningful steps towards more energy efficient, sustainable construction.

The Calgary Home Builders' Association spearheaded the Built Green Alberta program, which has now been adopted by BC homebuilders as a means to advance green building. Other regions are considering signing on to the program.

The Built Green program is modeled on and builds on the R-2000 and EnerGuide for New Houses programs as well as Built Green Colorado. The energy performance standard requires a minimum energy performance (an Energuide rating of 72 for Bronze, 75 for Silver, and 77 for Gold, plus a minimum number of points on a Green Checklist).

Although the standards are modest when compared to the R-2000 Standard which has a strict pass or fail test, or what environmentalists would like to see, they do provide a mechanism for production builders with spec housing to upgrade their products. The tiered standard is a way to encourage builders to go further than the minimum. It is interesting to see that some builders are making an effort to move beyond the strict requirements of the programs.



Avalon Central Alberta, which has been in business for 20 years, builds both single and multi-family homes in Calgary and Red Deer. They have made it their mission to build all their homes as Net-Zero energy homes by 2015 for no additional cost to the consumer while creating homes people will love to live in. They have just opened their Discovery Home. The built home generates enough power to send some back to the utility so that annually the home should produce enough power to offset the amount purchased resulting in a zero usage balance.

## Avalon Discovery Home Specs

### Building Envelope

#### Wall Framing

2x6 framing, R-20 batt insulation plus 2" extruded polystyrene wall sheathing (R-10) for a total nominal insulation level of R-30. Avalon's standard wall is 1 ½" extruded polystyrene on 2x6 framing with R-20, for a nominal thermal insulation value of R-27.5. This compares to standard industry practice of 2x6 framing, with R-20 batt insulation.

#### Ceiling Insulation

Blown-in loose fill insulation or batt to a total nominal thermal R-Value of R-50. This compares to Avalon's standard of R-40, and the Alberta industry practice of R-36.

#### Foundations

R-10 extruded polystyrene to foundation walls and under the full basement slab plus R-20 batt insulation in the walls. This compares to Avalon's standard practice of R-20 in the basement walls, and the industry practice of R-12.

#### Air Sealing

Air leakage is an important source of heat loss, as well as a potential source of moisture that can lead to deterioration of the structure. Careful attention to air sealing is important. Low expan-

### What Is Avalon's Net-Zero Electricity Home?

A home that is not only an energy efficient Built Green™ home, but also produces its own electric power. Like a typical home, a Net-Zero Electricity Home is connected to and takes electricity from the local utility, but unlike a typical home, this home may at times produce enough power to send some back to the utility. On an annual basis the home produces enough electricity to offset the amount purchased resulting in net-zero annual electricity consumption.

sion foam insulation is used around all exterior penetrations such as doors, windows, vents, wires and pipes. Expanding foam is a great insulator and air barrier. It also prevents moisture from getting into wall cavities and causing problems such as rot and mold.

The industry standard practice is to fill cavities and penetrations with batt insulation or acoustical sealant and to have joints in air barrier acoustically sealed in non-solid locations.

### Windows

Windows are the weakest component in the building envelope – in effect they are thermal holes. High performance windows do more than just lower energy bills – they deliver more comfort, create less condensation and protect valuables from sun damage better than conventional clear glass double-paned alternatives.

The demonstration house has triple glazed, low-E, argon-filled windows on the north, east and west orientations and double glazed Low-E windows on the south. This compares to the standard practice of clear double-glazing.

## Mechanical Systems

### Integrated Heating System

Instead of a traditional natural gas furnace and separate domestic water heater, this house has a combined system with an air handler that takes heat off the domestic hot water heater which is preheated by a solar system.

Standard hot water tanks keep a whole tank of water hot for when users might need it, constantly reheating the water. The hot water in this house is supplied by an instantaneous water heater that has no pilot light. The tankless water heater fires up only when hot water is needed. Incoming water to the heater is preheated by a solar panel eliminating the need for a water heater during most of the summer/early fall. The solar heated water is stored in an insulated storage tank.

### Energy Recovery Ventilator

When a home is built air-tight, special consideration needs to be made for how to mechanically ventilate the home to ensure adequate fresh air and suitable humidity is maintained inside. An Energy Recovery Ventilator (ERV) utilizes the heat in the warm air that is being exhausted to preheat the cold replacement air that is being brought in. The ERV can be set to run automatically throughout the day, providing constant ventilation without having to constantly heat cold outdoor air. Also, an ERV is designed to remove much of the humidity from the warm indoor air being exhausted and add it to incoming air, thus eliminating the need for a humidifier. It essentially utilizes the natural humidity created in homes through bathing, cooking and breathing to keep the home at reasonable humidity level. This will keep the home comfortable and healthy.

### Dual Fresh Air Intakes and Solar Preheat Wall

The Avalon Discovery Home has "summer" and "winter" fresh air intakes to draw the coolest air possible in the summer from the shaded northeast side of the home and the warmest air in winter from the south side. The "winter" intake also has a solar wall panel -- a ventilated, corrugated black metal panel that the sun heats up, thus warming the air behind it. Consequently, before the air is drawn into the home, it has already been preheated.

### Compact Fluorescent Light Bulbs

All light bulbs (even lamps) in the Avalon Discovery Home are energy efficient compact fluorescents. This reduces the electricity consumed by lighting by more than 70%. In the garage, high output fluorescents not only reduce power consumption but also give better garage lighting for those who like to tinker in their garages.

### High Efficiency Appliances

The Discovery Home includes a natural gas-powered range/oven and a gas dryer, which eliminates almost all electricity required for these appliances. Upgrading the dishwasher, clothes washer and fridge to the most electrically economical models on the market also contributes to significant reductions in electricity (and fresh water use).

Even when not in use, microwaves, stereos, audiovisual equipment, televisions, computers and electric razors draw electricity if plugged in. Some appliances such as microwave ovens actually use more power in an average year when they are not in use. By installing switches for the plugs that are likely to power these base load appliances, the amount of electricity required can be reduced without the inconvenience of unplugging and re-plugging each when they are used. ☼



# Technical Research Committee News

## Changes to Canada's Radon Guideline

Health Canada will be revising Canada's radon guidelines from 800 to 200 Bq/m$^3$.

Radon is a colorless, odorless and chemically inert radioactive gas that occurs naturally in the environment. It is produced by the natural decay of uranium found in most soils and rocks. The concern is that lung cancer is associated with radon exposure, specifically through the inhalation of radon and its radioactive decay products.

Although studies of uranium miners have shown a direct relationship between radon exposure and lung cancer, until recently there was little direct evidence of a link between radon levels in the home and lung cancer. However, recent studies in North America and Europe have shown that the lung cancer risks of radon in homes extend well below the current Canadian radon guideline of 800 Bq/m$^3$.

Smokers and those exposed to second-hand smoke are especially vulnerable since the risk from radon and tobacco is more than additive. The lifetime risk to a smoker exposed to a radon concentration of 800 Bq/m$^3$ is about one in three. In 2000, an estimated 1,600 lung cancer deaths in Canada were attributable to radon exposure.

Based on this recent data, Health Canada has recommended that the guideline for exposure to radon should be lowered from 800 Bq/m$^3$ to 200 Bq/m$^3$.

### The Building Code and Soil Gas Control

Radon gas, along with other soil gases, can move into homes through small cracks in concrete walls and floors, sumps, and other penetrations whenever there is a pressure differential between the basement and the adjacent ground, which can be a common condition.

The Building Code has required for some time that all wall, roof and floor assemblies in contact with the ground be built to resist the leakage of soil gas from the ground into the building. Two methods are outlined in the Code – airtight barriers and subfloor depressurization. The depressurization approach is limited to single-family dwellings.

A subfloor depressurization system is required by the Code only if radon levels are shown to be high. Radon levels can't be determined until after the building is completed - at which stage it is too late to install the granular fill and pipes. Thus, where a soil gas barrier is not installed in the floor, allowance for subfloor depressurization is required. This can include:

- At least 4" of coarse, clean granular fill (6" in the vicinity of the extractor pipe) to allow soil gas to move from anywhere under the slab toward the extraction pipe,
- A pipe that can be connected to extraction equipment if necessary, installed near the center of the floor, and
- If an extraction system is necessary, provision for makeup air.

The Code doesn't require extraction to be achieved by a powered fan, but it is clear that a fan is implied.

Soil-gas barriers under concrete slabs-on-grade must be 6 mil polyethylene sheet lapped at least 12". Joints don't have to be sealed as it is assumed weight and contact of the concrete will press the lapped edges together. Damage to the polyethylene during concrete placement is to be expected, and minor discontinuities that are not healed by hardened concrete are not considered

**Canadian** Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
www.chba.ca

## Measuring Radon

Radon radioactivity is measured in becquerels (Bq). One becquerel corresponds to the disintegration of one atomic nucleus per second. Radon concentration in air is measured as the number of transformations per second in a cubic metre of air (Bq/m$^3$). The average radon level outdoors varies between 5 and 15 Bq/m$^3$, but both higher and lower values have been observed.

The World Health Organization estimates that mean indoor radon concentration is about 39 Bq/m$^3$, with marked variation between countries. Very high radon concentrations (>1000 Bq/m$^3$) have been found in countries where houses are built on soils with a high uranium content. Hot spots in Canada include the Prairies, northern Ontario, Newfoundland, and portions of Atlantic Canada.

Radon concentrations within a home can vary from day to day and from hour to hour. Because of these fluctuations, estimating indoor radon concentrations air requires reliable measurements over a period of time.

Most countries have adopted a radon concentration of 200–400 Bq/m$^3$ for indoor air as an action or reference level above which mitigation measures should be taken to reduce the level in homes. The choice of action levels generally has been based on the concept of acceptable risk, i.e. these levels are thought to represent population health risks similar to other everyday risks.

critical as they are not likely to be lined up with the cracks in the concrete. The perimeter and any penetrations of floors on ground must be sealed.

Dealing with soil gases using a coarse, porous fill material below the house also can deal with moisture problems. Many foundations can be a source of excess water into the house, as the footings and foundation walls can act as wicks drawing ground moisture inside by capillary action. A coarse granular layer below the foundation will also act a capillary break for ground water.

Although Vancouver does not have radon-bearing soils, some builders are placing a course granular fill in the excavation and then building on top -- this is done as a way to keep the site cleaner and less muddy in Vancouver's wet climate. ☼

## Sidewall Vented Gas Appliances

As the saying goes, a picture is worth a thousand words. We've reported in the past on the concerns about the placement of vents for new high efficiency gas fired appliances. The flue gases from natural gas combustion contain considerable amount of moisture, which could be a problem to construction assemblies.

John Carroll from Saskatoon has provided these photos to show what can happen with sidewall vents. We've also seen a similar situation happen during a cold spell in Vancouver, as shown in the picture. Contractors have also observed condensation and mould growth on the neighbouring house caused by the moisture build up from a side wall vented flue, while the neighbouring house was still under construction.

We don't want to discourage the use of high efficiency appliances that can be vented through the sidewall. However, it would be prudent for builders to consider where the vents are placed. The best place is to put them in the roof, as long as the allowable equivalent vent length is not exceeded. A 2, 3, or 4-inch vent pipe is still much easier to deal with than traditional B-vents or chimneys. By venting the flue gases through the roof, they would act very much like traditional chimneys, and not create a problem for adjacent construction assemblies. ☼

*Sidewall vented water heater in Saskatoon area home.*

*Sidewall vent for tankless water heater in Vancouver, BC*



## BC Adopts New Energy Efficiency Standards

The BC government has approved new minimum energy efficiency standards for equipment and components used in new construction.

***Gas-fired forced air furnaces*** (less than 225,000 BTU/hr capacity) will have to be condensing units at least 90% efficient (AFUE). The effective date will be January 1, 2008. These units do not require chimneys or B-vents, so there will be some changes to conventional practices for those that still use conventional mid-efficiency furnaces.

***Windows***, including skylights and doors, will have to have a U-value no greater than 2.0 W/(m²-°K) effective January 1, 2009. This is the equivalent of an R-value of 2.8. In effect, this requirement will mandate high performance window units. The determination of acceptable units will be done in accordance to wither *CSA A440.2-04 Energy Performance of Windows* or *NFRC 100-2004 Procedure for Determining Fenestration Product U-Factors*.

***Thermostats*** used for line-voltage electric heating, including wall mounted, built-in, and two component thermostats must have a maximum differential of 0.5°C and a maximum droop of 2°C. This requirement becomes effective January 1, 2007.

***Gas and propane fireplaces***, including inserts and free-standing stoves will have to be labeled (on the unit itself) with their efficiency rating determined in accordance with CAN/CSA P 4.1-02. This requirement becomes effective January 1, 2007.

***Gas and propane fired boilers*** with an input greater than 300,000 BTU/hr will have to have a combustion efficiency at least 80%. This requirement becomes effective January 1, 2007.

## Ontario Adopts New Energy Standards

The 2006 Ontario Building Code introduces the highest energy standards in Canada. The higher energy-efficiency requirements balance energy efficiency with the affordability of a home. The extra cost to build a home in 2007 to the new higher energy-efficiency standards is estimated to have a simple payback of three years through reduced energy bills. This will result in substantial long-term savings for homeowners as well as reduced greenhouse gas production.

A typical new house built in 2007 under the new Building Code will be at least 21% more energy efficient than one built under the current Building Code. This will be achieved through requirements for:

- More energy efficient windows (67% more energy efficiency)
- Higher insulation levels (ceilings insulation increased 29%, walls 12% and foundation walls 50%)
- High-efficiency gas and propane-fired furnaces (90%).

New houses built under permits applied for in 2009 will require near-full-height basement insulation.

New houses built under permits applied for in 2012 will be required to meet standards substantially that will provide a house meeting an EnerGuide for New Houses rating of 80. The Energuide 80 rating has been included as an immediate compliance option.

Other changes will:

- Set new construction standards that will make buildings more accessible to people with disabilities.
- Facilitate the building of small care homes by increasing flexibility in the design of such facilities.
- Make constructing small residential buildings easier.
- Contain a new format that allows more creativity in building design while maintaining public safety.

The new Building Code will also be more closely aligned to the National Building Code, which is adopted in other provinces. The resulting similarity of standards will benefit Ontario product manufacturers, designers and builders who wish to operate in other Canadian jurisdictions.

Most of the changes set out in the new Building Code will be in effect December 31, 2006. Some energy efficiency changes, however, will not come into effect until the beginning of 2009 and others in 2012, to give the building industry time to prepare for the new requirements.

Certain enabling provisions, including those that promote the use of green technologies such as solar photovoltaic systems and solar hot water systems and those that promote flexibility in the design of small care homes, come into force immediately. ☼

# Energy Answers

*Rob Dumont*

*Over the years you have presented mostly good ideas for energy efficiency and renewable energy. Do you have some bad ideas that can serve as warnings to others?*

It is said that every person has a purpose in life, but in some cases the only purpose seems to be to serve as a bad example for others.

Here are some bad examples and bad ideas.

*1. Using interior window insulation on windows in cold climates.*

While fine in theory, the basic problem is condensation on the window surface. The insulation causes the window to get cold, and air will usually leak around the perimeter of the insulation. Any surface colder than about 10 C will usually condense water. I have experimented with the technique myself by placing a 2-inch (50 mm) thick beadboard insulation at night on some large windows. In very cold weather, parts of the insulation would freeze to the window! The large amounts of condensation on the window also encouraged the growth of mold. Definitely a bad idea.

If you absolutely must put insulation on windows in a cold climate, put the insulation on the outside of the window.

*2. Short cycling a conventional furnace.*

One way to improve the efficiency of conventional furnaces is to short cycle the burners. By having the burners cut out prematurely, the heat exchanger in the furnace will be colder, and will extract more heat from the combustion gases, resulting in a more efficient furnace.

Once again, the big problem with this technique is condensation. In this case it is condensation of the exhaust gases. Any surface in the furnace, the vent pipe and the chimney that is in contact with exhaust gases and is below about 55 ° C (130 °F) will condense the exhaust gases. Water and acids will result, and these will eat away the heat exchanger. The first parts of the heat exchanger to fail are the corners, as these tend to be the coldest. Most conventional furnaces use mild steel, which is prone to acid corrosion.

One way to short cycle a conventional furnace is to increase the heat anticipation on the thermostat, or to decrease the temperature deadband on the thermostat. The heat anticipation circuit prematurely shuts off the furnace. A narrow temperature deadband on a thermostat has the same effect.

An experienced furnace installer who has observed many heat exchanger failures told me that this short cycling phenomenon is likely the single greatest cause of furnace heat exchanger failures.

Don't short cycle your furnace!

*3. Running the furnace fan continuously to save energy.*

Another bad idea. It is true that a continuously running furnace fan will cause a slightly cooler heat exchanger in the furnace and will extract slightly more energy from the exhaust gases. However, as I have mentioned above, a cool heat exchanger made of mild steel is an accident waiting to happen.

In addition, what you might save on space heating will most likely be lost in an increased electricity bill. Most conventional furnaces have a 400- to 500-watt furnace fan. If you run the furnace fan continuously year-round, you will use 3500 to 4400 kilowatt hours per year. This amount of electricity use is very substantial compared to the 8000 kilowatt hours per year that most houses use for electricity (assuming fossil fuel is used for space and water heating.)

A second problem with continuous fan circulation occurs when central air conditioning is used. To properly dehumidify a space, a furnace with a central air conditioner should have the furnace fan cycle on and off. During the off cycles, the water that condenses on the cold (evaporator) coil in the furnace will have a chance to drip, hit the drain pan, and go down the drain. If the furnace fan runs continuously, the water that accumulates on the cold coil will re-evaporate into the air when the compressor is in the off cycle.

Thus, for these two reasons, don't use continuous fan operation.

If you do want to have the furnace fan run periodically, a device called the Air Cycler™ can be bought for about $125. It is a device that hooks on to your thermostat and allows you to run the furnace fan for a given number of minutes per hour. In my opinion, running the fan 10 minutes an hour should be ample.



*4. Using a cheap water heater to provide direct heat for radiant floor heating in a building.*

"The bitter taste of poor quality remains long after the sweet taste of low price is forgotten." John David Stanhope.

While water heaters are very cheap compared with boilers, they are generally not appropriate for use as low temperature heaters. Most radiant floor heating systems only need a water temperature of about 90°F to provide sufficient heat to a well insulated house. The water returning to the water heater from the radiant floor system will typically only be at about 80°F.

Running 80°F water continuously into a water heater will cause the exhaust gases to condense and rust out the central flue of the water heater. Water dripping off the central flue may also cause the burners to generate carbon monoxide, a killer gas.

A set of valves can be used to ensure the water temperature returning to the boiler is high enough to cause condensing, but the system must be set up very carefully so as to provide a sufficient amount of heat while returning warmer water to the water heater. Essentially a recirculation loop goes to the water heater and a parallel line off the recirculation loop goes to the radiant floor pipes. But you must ensure that the returning water temperature to the water heater is high enough (120°F or more) to prevent condensation.

I have used a water heater to heat a house, but I used a fan coil to distribute the heat. The water returning to the water heater is at a much higher temperature and my water heater has lasted about 20 years here in Saskatoon. (The fact that I replaced the anode rod also helped.)

*5. Lowering the water temperature thermostat in your water heater below about 122°F (50 °C).*

It is true that a lower water temperature in the water heater will cause lower heat losses from the tank. Unfortunately, legionella will grow in the water heater tank with cooler temperatures.

Some people were advocating lowering the water temperature to as low as 105°F as this is the temperature that people would use for baths and showers. Definitely do not lower the tank temperature below 120°F.

One characteristic of the above five bad ideas is that they all involve problems with water or water vapour.

One of the pioneers in Building Science, Gus Handegord of the National Research Council of Canada, once said that the two greatest problems in buildings are moisture from outside and moisture from inside. He was probably right.

NRC·CNRC

# Hybrid Heating Research for Houses

*by James Reardon*

The majority of new houses built in Canada are equipped with combustion-fired, forced air heating systems. The energy efficiency of Canadian housing has been dramatically improved over the past three decades due to improvements to forced air heating systems and to the construction of housing envelopes. With the participation of other federal government department partners and several manufacturers, the National Research Council's Institute for Research in Construction (IRC) is seeking further energy efficiency improvements by examining hybrid-heating schemes suitable for houses that can provide thermal comfort, acceptable indoor air quality and further improve energy-efficiency. This research project is examining whether heating efficiency can be improved by combining the best features of hydronic (water-based) heating and forced-air heating and may have a significant impact on Canada's energy consumption and greenhouse gas emissions.

The advent of electronically commutated motors to drive the blower and exhaust fans in high-efficiency, fuel-fired, forced air furnaces has substantially improved the energy efficiency of delivering thermal comfort via forced air. However, forced air heating may not be the most energy efficient way to deliver thermal comfort to occupants.

Hydronic-based, radiant floor heating is becoming more popular due to the comfort advantages of a warm floor. In addition to comfort, hydronic radiant heating may offer a more energy efficient means of delivering thermal comfort to the occupants due to the economies of the comparative heat capacities of water and air. By delivering part of that comfort radiantly, it may allow indoor air temperatures to be reduced without compromising comfort, thereby also reducing conduction heat loss through walls and windows.

Previous IRC research confirmed that central forced air heating systems mix the air well in a house, thus helping to ensure that infiltration and ventilation supply air can reach all occupants of the house, regardless of whether adequate distribution of thermal comfort is always achieved.

A completely hydronic approach to home heating does not provide this indoor air distribution, so supplementary ventilation systems are needed for houses without forced air heating, and their performance and operation will add to the total energy consumption in the house. Thus the hydronic radiant floor heating system and its supplementary ventilation system must be considered together for a comparison with forced air heating systems.

Hybrid heating systems combining radiant floor and forced air heating may provide improved thermal comfort and greater energy efficiency for the house overall. This project is being done in parallel with a project investigating residential hybrid ventilation systems to take advantage of the overlaps in considerations for acceptable indoor air quality and thermal comfort.

The objective of the IRC research is to evaluate the relative performances of a forced air heating system and a hydronic, radiant floor heating system in terms of heating energy consumption, thermal comfort delivered and the energy required to deliver that thermal comfort in the same house. Hybrid combinations of forced air and radiant floor heating will also be examined.

This research study is being carried out in a newly renovated and upgraded two-storey research house located on the Montreal Road campus of NRC in Ottawa. The research house has been upgraded to current building standards. It has been provided with a modern forced air heating system and hydronic heating for all areas of the floors (except the basement). Both heating systems are fully zoned which means that researchers can assess the efficiency of various combinations of forced air and hydronic heating to provide the necessary level of heating comfort. Automated data acquisition and control systems have been upgraded, envelope pressure distribution measurement coverage has been expanded, and an extensive network of surface temperature and relative humidity monitoring has been implemented. In two identical rooms, robotic 3-D systems have been assembled to allow automated, round-the-clock monitoring of indoor environmental parameters and thermographic surveys of surface temperature distributions. An automated multi-tracer gas dosing and sampling system has been upgraded, and occupancy is simulated by computer controlled electrical appliances and humidity generators.

*Jim Reardon is a Senior Research Officer with IRC's Indoor Environment group.*





To account for the fact that heating requirements may vary during the course of experiments, the reference house of the Canadian Centre for Housing Technologies, located nearby on the NRC campus in Ottawa, will serve as an experimental control reference to ensure that the performance monitoring periods are challenged by equivalent heating demands.

Experiments with various approaches to ventilation and measurements of the air exchange rates and indoor air distribution will be included in the test schedule to evaluate the impact on energy consumption and indoor air quality of the different heating strategies tested. These experiments are to take place during the 2006/2007 heating and shoulder seasons.

In addition to this planned hybrid heating research, Natural Resources Canada is conducting research to improve the aerodynamic efficiency of forced air system fans. This could further boost the energy efficiency of hybrid heating systems.

The outcome from this hybrid heating research is expected to provide a comprehensive evaluation of the comparative energy and comfort benefits of each approach to home heating. This quantitative information will provide valuable input to national energy policies aimed at reducing Canada's energy consumption and greenhouse gas emissions. The project's results will also help the industry and consumers make better informed, objective choices about the heating systems for renovations and new house construction.

Readers can obtain more information from these websites:
Hybrid heating research: *: http://irc.nrc-cnrc.gc.ca/ie/iaq/factsheet12_e.html*
Research house facility:*hhttp://irc.nrc-cnrc.gc.ca/ie/facilities/testhouse3_e.html*

# Radiant Insulation Claims

We've reported on exaggerated claims that have been made by some distributors of radiant barrier foils in Canada and the US. It seems that same issue has emerged in Europe.

The Advertising Standards Authority in the UK has issued an order against Actis Insulation Ltd. The company manufactures a product that is a complex arrangement of multiple layers of foils – for use in roof installations. The claim made was that the product, which is only 30mm (1 1/8" thick), is equivalent to 200 mm (8") of mineral wool.

The ruling notes that although the manufacturer had tested their product and a mineral wool in two separate roof installations, they had not used standard industry testing methods. The report provided by Actis in support of their argument did not include enough detail to support their claims.

The moral of the tale is if a manufacturer makes extravagant claims, they may well be outrageous. Due diligence and caution is required when evaluating any product.

**SOLPLAN REVIEW** is an independent Canadian Journal published 6 times per year to serve the needs of professionals and interested lay persons. It provides news, technical details, new product information, insights and commentary on developments covering all aspects of building science and energy efficient building practice for new and retrofit residential construction. Technical information is presented in a clear, concise manner without resorting to jargon.

**SOLPLAN REVIEW** is an independent subscription supported publication that relies on the support of readers. If you are seeing this journal for the first time, and find it valuable, why not ensure that you don't miss any copies. Subscribe today!

YES, I WANT TO SUBSCRIBE TO SOLPLAN REVIEW

In Canada: 1 year: $51.94 ($49.00 + 2.94) [NB, NS, NL $55.86 includes HST]

2 years: $93.28 ($88.00 + 5.28) [NB, NS, NL $100.32 includes HST]

USA and other foreign: 1 year $56.00 per year, 2 years $102.00 (USA and other foreign in US funds).

Pay by: VISA ☐ MASTERCARD ☐ AMERICAN EXPRESS ☐ CHEQUE/CHECK ☐

Card No _____ Exp date _____

Signature _____

NAME _____

ADDRESS _____

_____

POST CODE _____

the drawing-room graphic services ltd.
PO Box 86627 North Vancouver, BC V7L 4L2
Fax: 604-689-1841
e-mail: solplan@direct.ca

GST registration: R105208805